**IN THE UNITED STATES DISTRICT COURT**
**FOR THE DISTRICT OF DELAWARE**

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|---|---|---|
| **In re:** | : | |
| | : | **Chapter 11** |
| **USG CORPORATION,** | : | |
| **a Delaware corporation, et al.,** | : | **Jointly Administered** |
| | : | **Case No. 01-2094 (JKF)** |
| **Debtors.** | : | |
| **USG CORPORATION, et al.,** | : | |
| **Movant** | : | |
| **v.** | : | |
| **OFFICIAL COMMITTEE OF ASBESTOS PERSONAL INJURY CLAIMANTS, OFFICIAL COMMITTEE OF UNSECURED CREDITORS, OFFICIAL COMMITTEE OF ASBESTOS PROPERTY DAMAGE CLAIMANTS AND LEGAL REPRESENTATIVE FOR FUTURE CLAIMANTS,** | : | **Civil Action No. 04-1559 (JFC)**<br>**Civil Action No. 04-1560 (JFC)** |
| **Respondents.** | : | |

# DECLARATION OF STEPHEN E. FIENBERG

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**Declaration of Stephen E. Fienberg**

I, Stephen E. Fienberg, declare as follows:

**1.** I am currently the Maurice Falk University Professor of Statistics and Social Science in the Department of Statistics, the Center for Automated Learning and Discovery and Cylab at Carnegie Mellon University in Pittsburgh, Pennsylvania. I have been engaged in this matter by the Debtors as an expert consulting on matters related to statistics. If called upon to testify at trial, I could and would competently testify to the matters asserted in this declaration.

**2.** I have been a professor at Carnegie Mellon University since 1980, except for 1991-1993, when I was Academic Vice President for York University in Toronto, Canada. Additional details of my professional career may be found in my curriculum vitae, a copy of which is attached hereto as Exhibit A.

**3.** I earned a Ph.D. in Statistics at Harvard University in 1968. Previously, I had earned a B.Sc. degree in Mathematics and Statistics at the University of Toronto in 1964 and an A.M. degree in Statistics at Harvard University in 1965.

**4.** I have engaged in extensive consulting activities for various state and national governments, as well as private entities. A detailed list of my public consulting activities may be found in my curriculum vitae.

**5.** In addition, I have consulted and testified in a number of litigated matters. A list of cases in which I have consulted and/or testified is attached hereto as Exhibit B.

**6.** I have been engaged by the Debtors in this matter as an expert consultant on issues related to statistics, including statistical sampling. In the context of that engagement, I have provided advice and input into Debtors' plan to conduct discovery in this matter by taking a representative sample of personal injury claimants ("Sampling Plan").

**7.** Generally, statistical sampling is a method of using established mathematical formulas to infer characteristics of a population by examining a "sample," or subgroup, of that population. Statistical sampling methods are widely used, both in litigation and other contexts, when examining the entire population would be impossible, impracticable, or highly inefficient and costly. In many circumstances, sampling is used because the ability to measure carefully from the sample often produces higher quality and more accurate estimates than one can obtain from direct measurement of the entire population.

**8.** For example, I am advised that there were approximately 150,000 claims pending against the Debtors at the time they filed their bankruptcy petition. Examining every one of those claimants to determine key characteristics, such as their level of exposure to any of Debtors' products that contained chrysotile asbestos, could be costly, time-consuming and impracticable. By defining a carefully constructed random sample of the overall population of claimants, however, one can use statistical formulas to infer with high accuracy characteristics of the overall population.

**9.** "Variance" is a measure of variability of a given value in a particular population. The square-root of Variance is called the "standard deviation," $\sigma$. (Conversely, Variance is equal to $\sigma^2$.) Statistically, assuming a Gaussian or normal distribution (*i.e.*, the typical bell-shaped curve) of values, there is a 67% likelihood[1] that any actual value will fall within plus or minus one standard deviation (*i.e.*, $\pm 1\sigma$) of the average value determined by sampling, and a 95% likelihood that any actual value will fall within 2 standard deviations (*i.e.*, $\pm 2\sigma$). For example, if the average weight in a population is 100 pounds and the standard deviation is equal to 10 pounds, then 67% of the population would fall between 90 pounds and 110 pounds, and 95% of the population would fall between 80 pounds and 120 pounds.

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[1] This "confidence interval" for the true population mean value is based on the concept of hypothetical repeated draws of samples and is the typical way statisticians and others express uncertainty regarding sample estimates.

**10.** Some characteristics, rather than having a continuous range of values, may be expressed as either true or false (*i.e.*, they may be considered as responses to "binary" questions). For example, it is either true or false that a person weighs more than 100 pounds. "Probability," which can be expressed as the quantity "$p$," is the likelihood that a given condition or event will occur in a given population. In the "weight" example, if 1 in 10 subjects within a population is heavier than 100 pounds, the probability of being heavier than 100 pounds in the population is 1/10, or 0.10.

**11.** By taking a sample of a group of subjects and determining what proportion of the sample has a given characteristic, one can extrapolate to determine the predicted proportion of the entire group that has that characteristic, $\hat{p}$.

**12.** The predicted proportion, $\hat{p}$, will have an associated uncertainty, because the true proportion, $p$, can be determined only by measuring the entire population. The uncertainty may be expressed as the predicted proportion, plus or minus an estimated level of uncertainty usually expressed as a multiple of the standard deviation (*i.e.*, $\hat{p} \pm \text{multiple} \times \sigma$). We calculate the estimated standard deviation, by using $\hat{p}$ in place of $p$.

**13.** The estimated variance associated with the probability measured in a statistical sample can be calculated as follows[2]:

$$\hat{\sigma}^2 = \text{Estimated Variance}\,(\hat{p}) = \frac{\hat{p}(1-\hat{p})}{n} \qquad [1]$$

where $n$ is the number of units sampled (*i.e.*, sample size) and $\hat{p}$ is the probability of the characteristic in the sample. The estimated standard deviation can also be calculated, by taking the square root of the estimated variance.

[2] These formulae are actually upper bounds on the variance and standard deviation. Because we are dealing with a finite population of size $N$, there is a correction term that reduces the variance. But in the present circumstances where $N$ is very large, e.g., $N$=150,000, we can effectively ignore this term. *See* William G. Cochran (1977) *Sampling Techniques*, 3rd Edition (Wiley, New York).

$$\begin{aligned}\hat{\sigma} &= \text{Estimated Standard Deviation } (\hat{p}) \\ &= \sqrt{\text{Estimated Variance}(\hat{p})} \\ &= \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}\end{aligned} \qquad [2]$$

**14.** An example further illustrates these equations: in a small city population, 100 people are sampled (*i.e.*, n = 100) to determine the probability of being heavier than 100 pounds. Of the 100 people sampled, 10 are found to be heavier than 100 pounds. (*i.e.*, the observed proportion of those in the sample who are heavier than 100 pounds is $\hat{p}$= 10/100 = 0.10). According to equation [1] above,

$$\hat{\sigma}^2 = \text{Estimated Variance } (\hat{p}) = \frac{0.10 \times (1 - 0.10)}{100} = 0.00090,$$

and the corresponding estimated standard deviation is: $\hat{\sigma} = \sqrt{0.00090} = 0.03$.

**15.** The normal distribution (*i.e.*, the typical bell-curve shaped curve) is used to approximate the distribution of the sample estimate, $\hat{p}$, about the true population, *p*. In a normal distribution, with repeated draws of samples, 95% of the possible results intervals of the form $\hat{p} \pm 2\hat{\sigma}$ will contain the true proportion, *p*.

**16.** Using the example above, one would conclude that, with 95% confidence, the true proportion, *p*, would be within two standard deviations ($\pm 2\hat{\sigma} = \pm 0.06$) of the estimated proportion, $\hat{p}$, of 0.10, or between 0.04 and 0.16. Stated differently, based on the 100-person sample, the sampling would result in our being 95% confident that between four and sixteen percent of the people in the small city are heavier than 100 pounds.

**17.** According to equation [1] above, the standard deviation $\sigma$ and the margins of possible error it is used to calculate do not decrease linearly as a function of sample size. In fact, in order to shrink the predicted margins of error by a factor of two, the sample size must be increased by a factor of four.

**18.** The standard deviation $\sigma$ and the margins of possible error it is used to calculate also vary according to the probability $p$ (*i.e.*, the likelihood that the condition or event will occur in the population). The following Figures 1 and 2 plot the values of Variance ($\hat{p}$) ("Var($p$)") and standard deviation ("Std. Dev."), respectively, against probability $p$, according to equations [1] and [2] above. The sample size is assumed to be $N = 200$. As the curves illustrate, the Variance($\hat{p}$) and Standard Deviation peak at p = .50 (*i.e.*, the condition or event is 50% likely to occur), and become smaller for very high or very low values of $p$ (*i.e.*, the condition approaches either 0% or 100% likelihood of occurring):

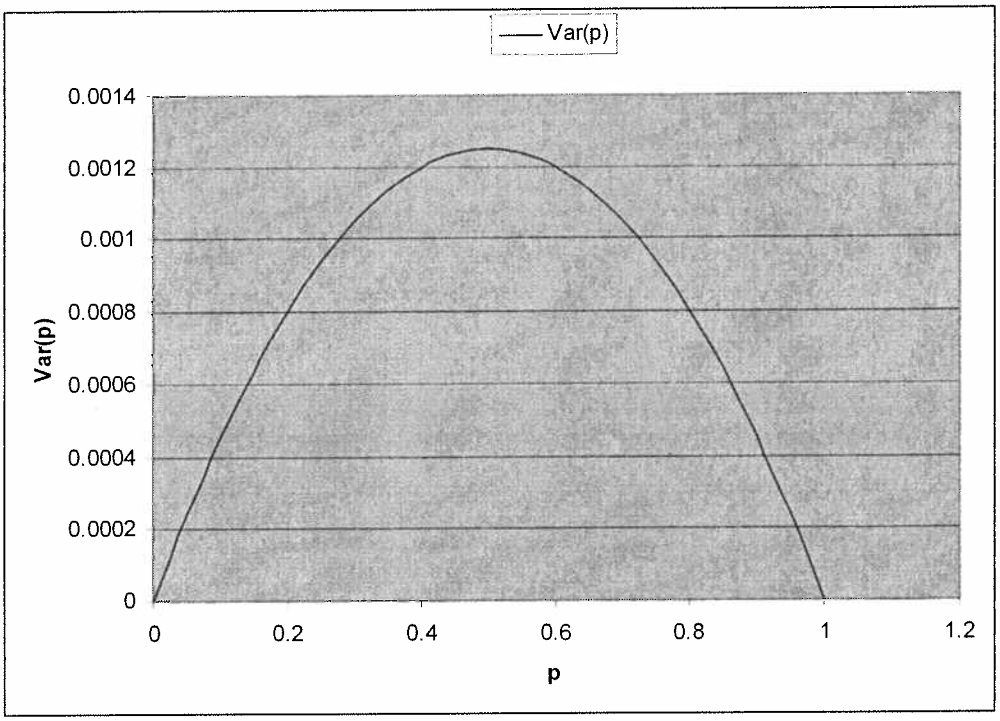


**Figure 1: Var(p) ($N = 200$)**

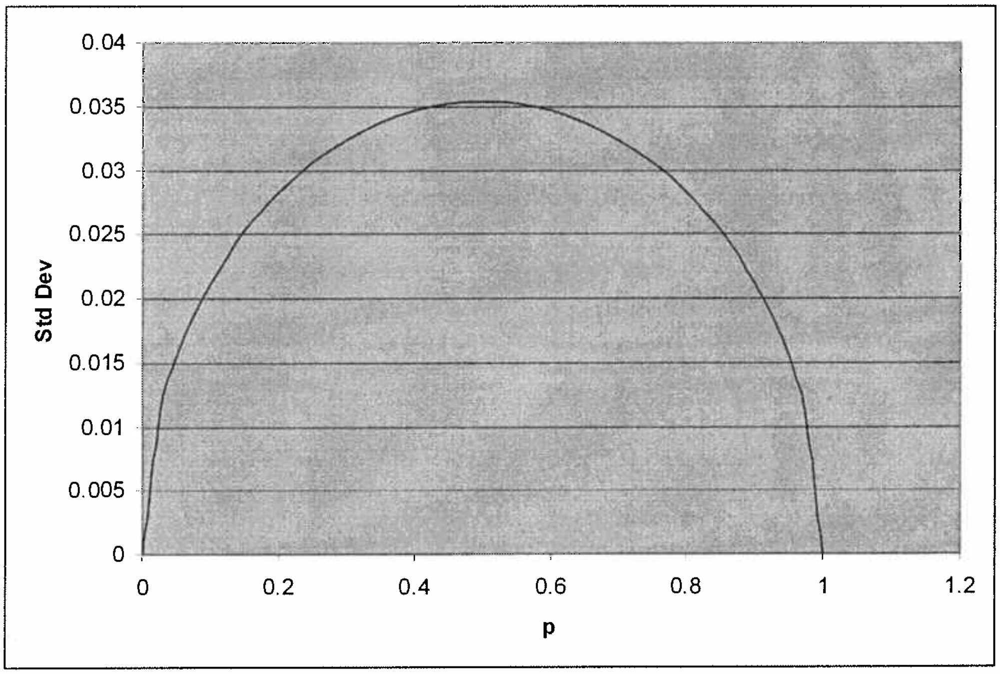


**Figure 2: Standard Deviation ($N = 200$)**

In other words, where a particularly high or low probability exists that an event or condition will occur, less variability results from the same sample size. As a result, in cases where particularly high or low probabilities are anticipated, a relatively small sample size may be used without giving rise to significant variability.

**19.** I am informed that the present case may present several binary questions, including, whether claimants have been exposed to a minimum threshold amount of chrysotile asbestos necessary to cause disease or harm.

**20.** I further understand that the claimants generally fall into basic categories based on the disease alleged—mesothelioma, lung cancer, other cancer, non-malignant asbestos disease, and unknown/unreported. I further understand that claimants' occupational history can be categorized as to whether claimants worked within the construction industry or did not work within the construction industry.

**21.** Where, as here, it may be useful to draw statistical conclusions specific to each disease category claimants, or each occupational category within each disease category, a "stratified" sampling plan, such as the Sampling Plan proposed by the Debtors in this matter, is appropriate. In a stratified sampling plan, the overall sample is divided into separate sub-samples taken from sub-groups of a population. The sub-samples may then be used to yield statistical conclusions for each sub-group. In addition, the overall combined sample still may be used to draw conclusions about the population as a whole.

**22.** Allocation of sample size across the 10 sub-groups of claimants (*i.e.*, the five disease categories, subdivided according to occupational history of having worked in the construction industry or having not worked within the construction industry) is a matter of choice. If greater levels of certainty (*i.e.*, smaller predicted margins of error) are required, additional samples within each sub-group could be collected.

**23.** More generally, if we were to assume a reasonable overall sample size (for the entire population of claimants, including all disease and occupational history categories) of 1000, an equal allocation among disease/occupational history categories break down as follows:

| | Mesothelioma | Lung Cancer | Non-Malignant Asbestos Disease | Other Cancers | Unknown/unstated |
|---|---|---|---|---|---|
| Construction | 100 | 100 | 100 | 100 | 100 |
| Non-Construction | 100 | 100 | 100 | 100 | 100 |

**24.** In this case, if overall sample sizes of 200 per disease category were used to determine the probability associated with any binary question, the ***maximum*** standard deviation associated with the estimated probability would be approximately 0.035. *See* Figure 2 above. Plus or minus two estimated standard deviations, which would yield the 95% confidence interval, would be plus or minus approximately 7%.[3]

**25.** The 7% error bounds stated above would shrink for any population probability value $p$ other than 0.5. The relationship between probability $p$ and calculable error bounds is illustrated in Figures 1 and 2 above and discussed in paragraph 17; however, an illustrative example may be helpful. If half of a 200 claimant sample of mesothelioma claimants have exposure to chrysotile asbestos deemed necessary to cause disease or harm ($\hat{p}$ = .5), using equations [1] and [2] above, we can say that the 95% confidence interval for the true proportion, $p$, of all mesothelioma claimants having such exposure is within approximately 7% of the sample proportion. If, on the other hand, 1 in 10 of the sample of mesothelioma claimants have exposure to chrysotile asbestos deemed necessary to cause disease or harm ($\hat{p}$ = .1), those same equations allow us to say that the 95% confidence interval for the true proportion, $p$, of all mesothelioma claimants having such exposure is within approximately 4% of the sample proportion. The actual values of the interval to be used will thus depend on the outcome from the sample.

**26.** Constructing a random sample of 1000 claimants stratified in the manner described is relatively straightforward, and can be accomplished by following the following steps, as set forth in Debtors' Sampling Plan:

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[3] I say "approximately 7%" to account for the fact that the disease category sample of 200 will consist of sub-samples of 100 construction and 100 non-construction claimants. These two sub-samples may have different proportions of claimants with the characteristic being measured. Depending on the size of the difference in these proportions between the two sub-samples, the maximum error bounds may increase, but will not increase by more than 3%. But for sub-samples even as discrepant in size as in a ratio of 2 to 1, the value will increase by less than 1%.

**a.** First, each of the approximately 150,000 personal injury claimants in the existing CCR database will be sorted into 10 groups corresponding to the 5 disease categories subdivided by occupational category (*i.e.*, occupational history in construction or non-construction), with claimants in each group sorted alphabetically by state of residence.

**b.** For each of the 10 disease category/occupational history groups, labeled $i=1,2,\ldots,10$, a sampling ratio $N_i/n_i$ will be determined to produce a total stratum size sample of 100. (For example, if the stratum size was 20,000, the sampling ratio $N_i/n_i$ would be 200 because by selecting every 200th plaintiff from the stratum, you would end up with a sample of 100). A sub-sample for each disease/occupational history category will then be constructed by beginning with a random selected individual among the first $N_i/n_i$ names in the ordered list, followed by every subsequent $N_i/n_i$ th individual.

**c.** Individual claimants are sampled in this fashion until an overall sample of 1000 is constructed.

**d.** To get a sample estimate for a combination of strata or substrata one weights the sample results for the component subsamples using the true proportions for those strata or substrata in the population. These proportions are known quantities.

**e.** In a similar fashion to step **d.**, one can get estimated standard deviations for estimates based on combinations of strata and substrata through a similar form of weighting.

Thus this procedure yields representative samples for the strata and substrata as well as what is effectively a representative sample for the population as a whole.

I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct.

Dated: Aug. 19, 2005

By: ______________________
Stephen E. Fienberg



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